

WP 15-MD3102

Revision 4

Event Investigation

Management Control Procedure

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APPROVED FOR USE

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INTRODUCTION

This procedure establishes the Waste Isolation Pilot Plant (WIPP) methodology for conducting investigations of abnormal incident/event, as required by the Department of Energy (DOE) Order 5480.19 and WP 04-CO.01-6. This process applies to any incident/event at the WIPP that requires reporting in accordance with DOE O 231.1A, but also applies to incidents/events of lesser significance. This procedure applies to incidents/events that may involve WIPP personnel at locations other than the WIPP site, such as the Skeen Whitlock Building or Central Characterization Project (CCP) personnel. Incidents/events that are abnormal or undesired actions, activities, conditions, trends, or consequences that can or do influence project performance and may be reportable under DOE O 231.1A.

Events that meet the criteria for Type A or Type B investigations shall be handled in accordance with DOE O 225.1A. These types of events are investigated by DOE. Information generated through this process prior to initiation of a Type A or B investigation may be requested by DOE as part of their investigation.

Corrective actions resulting from debriefs, critiques, causal analysis, or root cause analysis are tracked through the WIPP Form associated with the incident in accordance with WP 04-IM1000. Corrective actions resulting from a Type A or Type B investigation are tracked in accordance with WP 13-QA3007.

Performance of this procedure generates the following record(s), as applicable. Any records generated are handled in accordance with departmental Records Inventory and Disposition Schedules.

- Original debrief/critique minutes
- Originals of personnel statements
- Applicable evidence records – photos/videos, sketches, logs, rounds sheets, surveillance records, strip charts, etc.
- Original debrief/critique attendance sheets
- Original causal analysis reports

REFERENCES

BASELINE DOCUMENTS

- DOE O 151.1C, *Comprehensive Emergency Management System*
- DOE-NE-STD-1004-92, *Root Cause Analysis Guidance Document*

REFERENCED DOCUMENTS

- DOE G 231.1-2, *Occurrence Reporting Causal Analysis Guide*
- DOE M 231-1-2, *Occurrence Reporting and Processing of Operations Information*
- DOE O 5480.19, *Conduct of Operations Requirements for DOE Facilities*
- DOE O 225.1A, *Accident Investigation*
- DOE O 231.1A, *Environment, Safety, & Health Reporting*
- DOE STD 1045-93, *Guide to Good Practices for Notifications and Investigation of Abnormal Events*
- WP 04-CO.01-6, *Conduct of Operations Program – Investigation of Abnormal Events*
- WP 04-IM1000, *Issues Management Processing of WIPP Forms*
- WP 12-ES3918, *Reporting Occurrences in Accordance with DOE Order 231.1A*
- WP 13-1, *Washington TRU Solutions LLC Quality Assurance Program Description*
- WP 13-QA3007, *External Oversight Activities*
- WP 15-GM1001, *Root Cause Analysis*

DEFINITIONS

Causal Analysis – The process of determining those most probable causes that explain why an incident/event happened that can be identified and that facility management has the control to fix and for which effective corrective actions to remedy the problem can be developed.

Critique – A formal process to investigate an incident/event that includes statements from the involved parties, from their perspective, input from activity, process, or equipment experts, documentation such as logs, strip charts, drawings, etc., and a review of applicable procedures, if any, to control the activity, such that the likely causes and corrective actions to remedy the problem can be generated.

Debrief – A meeting held as soon as practical after an incident/event to gather facts from involved individuals to assist in determining the circumstances of the event and

corrective actions to mitigate hazards caused by the incident/event and to prevent the incident/event from occurring again.

Debriefer – An individual who has been trained in human performance improvement interview techniques or equivalent. A debriefer may not have as much training as a trained investigator.

Event Investigator – An individual formally trained in investigation techniques such as Human Performance Improvement, TapRoot®, Phoenix®, or equivalent, to investigate incidents/events and determine the causes, corrective actions to prevent recurrence, and identify lessons to be learned. The individual is able to satisfactorily complete the identification of apparent causes associated with an occurrence using the Causal Analysis Tree in DOE Guide 231.1-2.

Near miss – An incident/event where no barrier or only one barrier prevented an incident/event from having a reportable consequence (DOE Manual 231.1-2). Can also be a situation in which an inappropriate action is taken (or a necessary action is omitted) but is detected and corrected before an adverse effect on personnel or equipment results (DOE STD 1045-93).

Reportable – An incident/event or condition to be reported to the DOE according to the criteria defined in DOE O 231.1A.

Root Cause – The most basic cause that explains why the incident/event happened, that management has the control to fix, and for which effective corrective actions to prevent recurrence of the problem and preclude occurrence of similar problems can be developed and implemented.

Root Cause Analysis (RCA) – A structured approach to identifying the factors that influenced the consequences of one or more events in order to identify the behaviors and conditions that need to be changed to prevent recurrence of similar consequences and to identify the lessons to be learned to promote the achievement of better consequences.

PRECAUTIONS AND LIMITATIONS

- If the incident/event is operations related, the Facility Shift Manager (FSM) or Facility Manager (FM) determines the immediate corrective actions required prior to the restart of operations.
- A trained and competent individual designated by the Senior Organizational Manager shall perform debriefs or lead event investigations.

- Incidents/Events that are reportable in accordance with WP 12-ES3918, require **timely** notifications and reporting. Completing investigative activities and associated RCA or Causal Reports within the timeframes specified below facilitates timely notifications and reporting required by WP 12-ES3918.
 - A debrief should typically be completed within the shift or before completion of the next shift with the report finalized by the next working day.
 - A critique should typically be completed within 1 to 7 working days following the incident/event.
 - A RCA should typically complete within 15 to 20 working days after reporting the event.
 - A causal analysis and corrective action plan should be completed as soon as possible, but within 45 calendar days of the event occurrence, as required by WP 12-ES3918.

PERFORMANCE

1.0 EVENTS REQUIRING INVESTIGATION

1.1 The following types of events require investigation:

- Design limits are violated (Technical Specifications, design requirements identified in System Design Descriptions, Technical Safety Requirements, design parameters/limits identified in the WIPP Documented Safety Analysis, or other limits that have been determined to safely operate the facilities and systems).
- System performance is unusual, abnormal, or unexplained.
- Safety conditions are abnormal or unexplained.
- Safety or system features are improperly positioned.
- Conditions reportable to DOE or other agencies (i.e., U.S. Environmental Protection Agency [EPA], New Mexico Environment Department [NMED], etc.).
- An unplanned shutdown or significant loss of operation occurs.
- A procedural violation or personnel error occurs that caused or could have caused serious personnel injury, equipment damage, or could have affected facility safety.

- Equipment failure occurs that could adversely affect operations capability or safety.
 - Radiological or toxic material limits are exceeded, or control of radioactive or toxic materials is lost.
 - Actual or attempted sabotage is suspected.
 - Chemistry or process parameters are out of specification or indicate unexplained trends.
 - A Department Manager, a Cognizant Manager, or a safety review committee deems an investigation is appropriate based on the repetitive nature of the problem or other reason deemed appropriate.
 - Loss of special nuclear material.
 - A near miss incident has occurred (see Definitions section – the RCA is required for a near miss as identified in DOE M 231.1-2 and WP 12-ES3918).
 - Personnel injury meeting applicable WP 12-ES3918 and OSHA reporting requirements.
- 1.2 Central Monitoring Room (CMR) Operator (CMRO), log the incident in the CMR narrative log **AND** notify the FSM.
- 1.3 FSM, notify the Responsible Manager, FM, and Facility Manager Designee (FMD) following an incident/event that is one of the event types listed in Step 1.1. If the incident involved bargaining unit employees, notify the bargaining unit representation.
- 1.4 FSM or Responsible Manager, ensure that injured personnel, if any, have received medical attention.
- 1.5 FSM/FM, categorize the event in accordance with WP 12-ES3918 **AND** make the necessary notifications.
- 1.6 FSM, update the CMR log based on actions taken in Steps 1.4 and 1.5.

NOTE

If an abnormal incident/event occurs at WIPP on the back shift, over the weekend, or any other time when limited personnel are available on site, the FSM acts in the capacity of the Responsible Manager and the FMD.

- 1.7 FSM or Responsible Manager, ensure that the scene of the incident/event is preserved in accordance with Section 2.0.
 - 1.8 Responsible Manager, identify personnel that are involved in the incident/event (e.g., initiator, helper, supervisor, and eyewitness).
 - 1.9 FSM or Responsible Manager, retain involved personnel on-site until debriefed, even if the debrief will extend past the end of the normal work shift. Call-in involved personnel who have left the work site.
 - 1.10 FSM or Responsible Manager, notify involved personnel of the debrief time and place. Interviewees may request their immediate supervisor or a bargaining unit representative to attend their interview.
 - 1.11 If personnel are unable to participate in the debrief in person, FSM or Responsible Manager obtain statements from involved personnel. An email or teleconference is also acceptable to obtain input, only in cases where the involved person is unable to attend the debrief.
 - 1.12 FSM or Responsible Manager, perform a debrief or assign an individual(s) trained in interview techniques to perform the debrief as described in Section 3.0.
 - 1.13 Responsible Manager, ensure that the incident/event has been reported to the CMR, and generate a WIPP Form in accordance with WP 04-IM1000, to document the incident/event.
- 2.0 INCIDENT/EVENT SCENE PRESERVATION
- 2.1 FSM or Responsible Manager, perform the following:
 - 2.1.1 Ensure that the facility/equipment affected by the incident/event is in a stable configuration. If anything needs to be moved to stabilize the scene, take pictures, sketches, and measurements prior to movement.
 - 2.1.2 Secure the incident/event scene to prevent alteration of the scene, or removal of evidence; use barriers, ropes, or investigation tape to help control access; the use of safety or security personnel may be necessary until barriers are in place.

- 2.1.3 Ensure that hazards, if present, following an incident/event, are posted as soon as possible following the incident/event to alert personnel.
- 2.1.4 Restrict access to the scene to those gathering data or taking pictures for the investigation, or actually conducting the investigation.
- 2.1.5 Ensure photos or videos of the scene, as appropriate, are taken as soon as possible following the incident/event. Include obstructions, equipment, parts, material, debris, spills, stains, and anything else that may contribute to understanding the incident/event. Include a reference object (a ruler, landmark, etc.) to aid in determining sizes, orientation, and distances in the photos. Record the date/time, location, orientation, and subject matter for each picture.
- 2.1.6 Ensure that applicable copies of logs, work packages, sign-off sheets, are collected to aid in the debrief.

3.0 INCIDENT/EVENT DEBRIEF

- 3.1 Debriefer, perform the debrief in accordance with Attachment 1.
- 3.2 Debriefer, finalize the debrief in the format identified in Attachment1, including supporting documentation.
- 3.3 Submit the original debrief and supporting documentation to the WIPP Form Coordinator and a copy to the following:
 - Responsible Department Manager
 - Responsible Manager
 - Manager of Site Operations and Disposal
 - Compliance Coordinator
 - FMD
 - Lessons Learned Coordinator
 - DOE Facility Representative (FR)
- 3.4 Responsible Department Manager, use the Culpability Decision Model in Attachment 4, to evaluate if the error is a negligent error. Any corrective personnel actions are beyond the scope of this procedure and involve the Responsible Manager and Human Resources.

4.0 EVENT INVESTIGATION PROCESS

- 4.1 Responsible Department Manager (or designee), if the debrief resulted in limited causes and corrective actions, or if a critique is required by Attachment 2 of WP 12-ES3918, assign a trained Event Investigator to conduct a critique.
- 4.2 If the incident/event requires a RCA, based on Attachment 2 of WP 12-ES3918; assign a trained Event Investigator to lead a RCA team in accordance with WP 15-GM1001.
- 4.2.1 A RCA is required for the following:
- Events that require immediate notification to DOE (DOE O 231.1A) as defined in WP 12-ES3918.
 - Events that have been categorized as Operational Emergencies, 1, 2, R, or Near-Miss as defined in WP 12-ES3918.
 - Events that require immediate reporting or notification to other agencies (i.e., EPA, NMED, etc.).
 - Significant issues/events from Price-Anderson Amendments Act (PAAA) violations reported into the DOE Noncompliance Tracking System (NTS).
 - Significant Conditions Adverse to Quality (SCAQs) as defined in WP 13-1.
 - Significant damage to equipment.
 - Significant violation of safety management programs.
 - Any other event as determined by the responsible Senior Organizational Manager.
- 4.3 Event Investigator, if a critique is required, assemble necessary information (i.e., debrief and supporting documentation, procedures, strip charts, log book pages, photos, etc.)
- 4.4 Event Investigator, schedule a critique meeting and send a meeting notice to the desired attendees, including the DOE FR, stating the time and location of the critique meeting.

- 4.5 Limit attendance to the following personnel:
- Event Investigator
 - Note Taker
 - Individuals directly involved in the event or follow-up actions and their immediate supervisor, a bargaining unit representative (if desired) and witnesses
 - Organizational Line Managers of the personnel directly involved in the event
 - Technical experts requested by the critique lead
 - Compliance Coordinator
 - FSM/FMD or both
 - DOE FR, although other DOE personnel may choose to attend
- 4.6 Conduct the critique in accordance with Attachment 2.
- 4.7 Draft the critique meeting minutes, distribute to critique attendees as necessary to ensure that critique is factual and accurate, and resolve comments such that the critique can be finalized within three working days.
- 4.8 Finalize the report by signing it and obtaining the Responsible Department Manager's signature.
- 4.9 Submit the original critique and supporting documentation to the WIPP Form Coordinator and a copy to the following:
- Responsible Department Manager
 - Responsible Manager
 - Manager of Site Operations and Disposal
 - Compliance Coordinator
 - FMD
 - Lessons Learned Coordinator
 - DOE FR

- 4.10 Responsible Department Manager, use the Culpability Decision Model in Attachment 4, to evaluate if the error is a negligent error. Any corrective personnel actions are beyond the scope of this procedure and involve the Responsible Manager and Human Resources.

5.0 CAUSAL ANALYSIS

- 5.1 Event Investigator, if a causal analysis is required by Attachment 2 of WP 12-ES3918, but not to the degree of a RCA, ensure that the identified causes and corrective actions identified in the debrief/critique are sufficient by performing the following:
 - 5.1.1 Reviewing the results of the debrief, critique, culpability decision model review, and associated documentation.
 - 5.1.2 Reviewing the chronology of events (timeline) and determine if there are missing data or facts that need to be identified and included.
 - 5.1.3 Conducting additional data gathering as necessary including document reviews, personnel interviews, equipment testing, consultation with experts, etc., to obtain the required information and facts related to the activities that occurred before, during, and after the event.
 - 5.1.4 Reviewing the identified Error Precursors, Flawed Defenses, and Latent Organizational Weaknesses against the available information, and determine if additional investigation is required.
 - 5.1.5 Conducting additional investigations and analyses as necessary to finalize the list of relevant Error Precursors, Flawed Defenses, and Latent Organizational Weaknesses.
 - 5.1.6 Reviewing the Error Precursors, Flawed Defenses, and Latent Organizational Weaknesses to identify the applicable cause codes using Attachment 5 of WP 12-ES3918.
 - 5.1.7 Identifying the lessons-to-be-learned, as applicable. The Test for Significant Causal Factors (Attachment 7), may be used to help identify the root cause and lessons-to-be-learned.
 - 5.1.8 Developing the causal analysis report documenting the results of the investigation such that the report includes a description of the event, timeline, summary of the fact finding and data gathering, identified causal factors including Error Precursors, Flawed Defenses, and Latent Organizational Weaknesses (Attachment 8),

applicable cause codes from WP 12-ES3918, and lessons-to-be-learned.

5.1.9 Including printed name, signature, and date for the Event Investigation Leader, team members (if any), and Responsible Department Manager.

5.1.10 Distributing the original causal analysis report to the WIPP Form Coordinator and a copy to the following:

- Responsible Department Manager
- Responsible Manager
- Manager of Performance Assurance
- Compliance Coordinator
- FMD
- Lessons Learned Coordinator
- Other (as determined by the Responsible Department Manager)

Attachment 1 – Debrief Guidance

1. Debriefs shall be conducted such that the following information, as applicable, is obtained:
 - a. Description of the incident/event – A summary that identifies the time, location, and a description of incident/event specifics.
 - b. WHO – Identify the participants involved before, during and after the incident/event and their respective roles/responsibilities.
 - c. WHAT/WHERE – Identify the sequence of activities leading up, during and immediately after the incident/event. Progressively question and rebuild how the world looked to people on the inside of the situation at each juncture, including the surrounding environment for identified activities.
 - d. WHEN – Identify with participants the critical junctures (moments in time when decisions and/or actions were required) in the sequence of events.
 - e. WHY – At each juncture in the sequence of events, determine the following:
 - What was observed, noticed or seen, or were different than what involved personnel had expected to notice?
 - What knowledge was used to deal with the situation? Did involved personnel have any experience with similar situations that was useful in dealing with this one?
 - What expectations did involved personnel have about how things were going to develop? What options did involved personnel think they had to influence the course of events?
 - How did other operations or organizational influences determine how involved personnel interpreted the situation and how they would act?
 - f. Additional questions may include the following:
 - What were you seeing?
 - What were you focusing on?
 - What were you expecting to happen?

Attachment 1 – Debrief Guidance

- If you have to describe the situation to your fellow crew member at that point, what would you have told him/her?
 - What mistakes were likely at this point?
 - Were you reminded of any previous experience?
 - Did this situation fit in a standard scenario?
 - Were you trained to deal with this situation?
 - Were there any rules that clearly applied here?
 - What other sources of knowledge did you rely on to tell you what to do?
 - What goals governed your actions at this time?
 - Were there conflicts or trade offs to make between goals?
 - Was there time pressure?
 - How did you judge you could influence the course of events?
 - Did you discuss or mentally image a number of options or did you know right away what to do?
 - Did the outcome fit your expectations?
 - Did you have to update your assessment of the situation?
2. Develop the Debrief Report with the following information:
- a. Description of event and sequence of event
 - b. Personnel at scene and role of each
 - c. Pictures
 - d. Personnel statements
 - e. Other Supporting evidence

Attachment 1 – Debrief Guidance

- f. Cause(s) – Such as error precursors, flawed defenses, latent organizational weaknesses, or communications weaknesses as depicted in the "Anatomy of an Event" Model and described in Attachments 3 through 8.
- g. Corrective Actions
- h. Lessons Learned
- i. Person(s) conducting the debrief

Attachment 2 – Critique Process

1. Before the Critique, the lead Event Investigator should obtain a copy of the debrief including supporting documentation such as operating logs, instrument recordings, work packages, relevant emails, photographs, accident debris or failed items, procedures applicable to the event, etc.
2. The lead Event Investigator should have copies of the Anatomy of Event Model, list of Error Precursors, Flawed Defenses, and Latent Organizational Weaknesses (Attachments 3-8) for reference during the critique.
 - a. During the Critique:
 - (1) Ensure that the note-taker is designated and understands responsibilities.
 - (2) Make introductions of everyone at the critique and identify their responsibilities.
 - (3) Establish the purpose of the critique with the attendees – emphasizing that the purpose of the critique is not to assign blame, but rather to determine what happened and why it happened to prevent reoccurrence.
 - (4) Establish the ground rules for critique conduct.
 - (5) Circulate an attendance sheet for completion.
 - (6) Recount the overview of the event, as you know it.
 - (7) Review the results of the debrief.
 - (8) Maintain order and decorum and control the flow of questions – including who asks the question and to whom it is directed.
 - (9) Pursue the following lines of investigation in the critique:
 - (a) Identify conditions before, during, and after the event – such as equipment status, locations of personnel, etc.
 - (b) Establish a chronology of the event (a timeline).
 - (c) Identify the actions taken or not taken before, during, and after the event.

Attachment 2 – Critique Process

- (d) Identify additional information that must be obtained following the Critique to facilitate the analysis of the event.
 - (e) Identifying Error Precursors that may have contributed to the event or its consequences. The Error Precursor List Attachment 5 provides examples.
 - (f) Identify Flawed Defenses (barriers) that allowed the event to occur or did not effectively mitigate the consequences. Attachment 6 provides examples.
 - (g) Identify Latent Organizational Weaknesses that may have allowed the event to occur. Attachment 8 provides examples.
- (10) Determine what occurred by asking open ended questions to obtain pertinent information. Ask the questions prepared prior to the Critique, allowing others to participate as the Critique progresses. Questioning need not be limited to prepared questions since new information will arise.
 - (11) Solicit questions and pertinent information from participants.
 - (12) Write key facts and a timeline on the board, as necessary.
 - (13) Verify the facts of the event.
 - (14) Conduct a timeline review, insert information from participants to ensure that all facts have been collected.
 - (15) Discuss actions taken before, during, and after the event and determine if there are actions that should or should not have been taken.
 - (16) Identify and document potential causes as determined from Error Precursors, Flawed Defenses or Barriers, and Latent Organizational Weaknesses, as applicable.
 - (17) Review action items and assignments.
 - (18) Identify any lessons learned.
 - (19) Thank attendees for their cooperation and input.

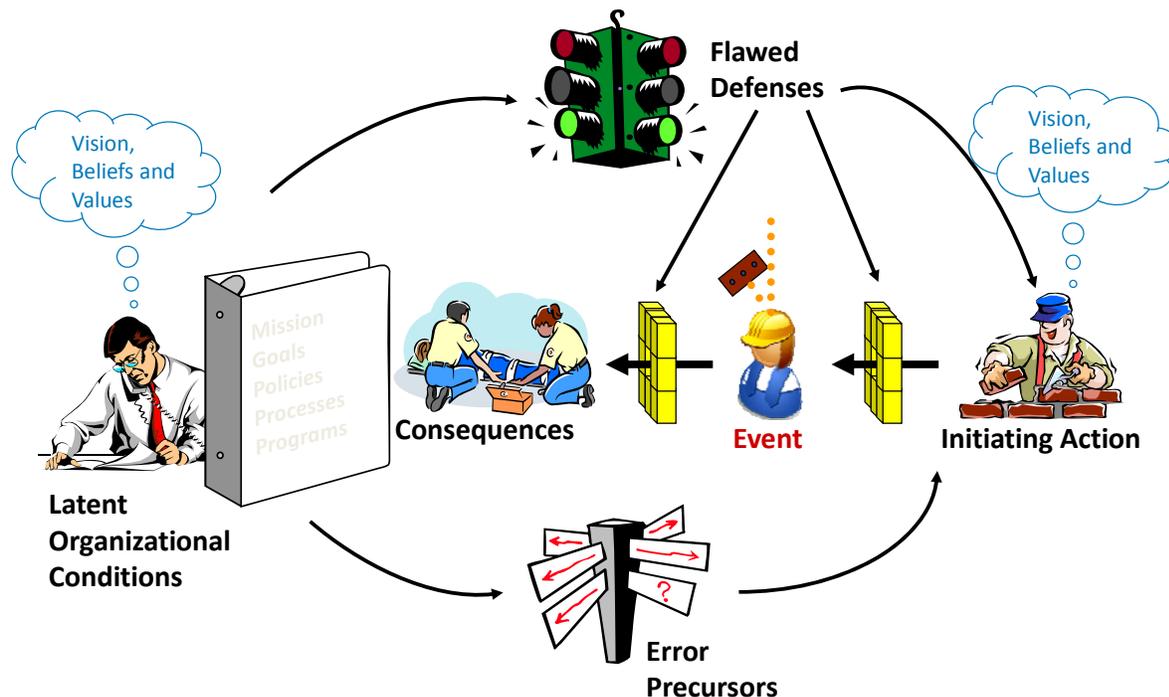
Attachment 2 – Critique Process

Example Critique Format

Washington TRU Solutions, LLC
CRITIQUE MINUTES

ORPS Reference Number: _____		
Event Title: _____		
Discovery Date/Time: _____	FM Notification Date/Time: _____	
Categorization Date/Time: _____	Other Notifications: _____	
	FMD Date/Time: _____	
Event Re-categorized? [] Y [] N Date/Time: _____ _____	Notification of Re-categorization Names/Dates/Times: FR _____ _____ DOE HQ _____ _____	Critique Meeting Held? [] Y [] N Date/Time: _____ _____
Location of Event: _____		
Pertinent Procedure Number(s) (if applicable): _____		
Description of Event and Sequence of Events (Timeline): _____		
Personnel at Scene and Role of Each: _____		

Attachment 3 – Anatomy of an Event Model



Events are caused. The significance, or severity, of a particular event lies in the consequences suffered by the physical plant or personnel, not the error that initiated the event. The error that causes a serious accident and the error that is one of hundreds with no consequence can be the same error that has historically been overlooked or uncorrected. For a significant event to occur, multiple breakdowns in controls or barriers must first occur. The Anatomy of an Event provides a picture of the elements that exist before an event occurs. Breaking the linkages will be more likely to prevent events.

Event – An unwanted, undesirable change in the state of facility structures, systems, or components or human/organizational conditions (health, behavior, administrative controls, environment, and so on) that exceeds established significance criteria. Other definitions include: an outcome that must be undone; any facility or organizational condition that does not achieve its goals; any undesirable consequence; a difference between what is and what ought to be. Events also include personnel injury and serious discrepancies with the project configuration documentation.

Attachment 3 – Anatomy of an Event Model

Initiating Action – An action by an individual; either correct, in error, or in violation; that results in an event. "Error" is an unintended departure from an expected action and usually involves cognitive (mental) failures in the processing of task-related information. They can be either acts of commission or omission. Active errors are those errors that have immediate, observable, undesirable outcomes in the physical plant. The majority of initiating actions are active errors. A "violation," on the other hand, involves a deliberate departure from expected behavior usually specified by policy or procedure. Violation involves motivational factors unique to the individual or endemic to the organization. Although violations happen from time to time, they are rare compared to the occurrence of error.

Error Precursors – Unfavorable prior conditions at the job site that increase the probability for error during a specific action, that is, error-likely situations. An error-likely situation—an error about to happen—typically exists when the demands of the task exceed the capabilities of the individual or when work conditions exceed the limitations of human nature. Human nature comprises all mental, emotional, social, physical, and biological characteristics that define human tendencies, abilities, and limitations. For instance, humans tend to perform poorly under high stress and undue time pressure. Error-likely situations such as these are also known as error traps. Error Precursors exist in the work place before the error occurs, and thus, errors are manageable. If discovered before the error, then the conditions can be changed to reduce the chance for error.

To improve the ability of people to interact and address the concept of error traps, it is easier to talk about Error Precursors using categories. Work can be described using attributes common to any work activity. Conditions associated with the following attributes can be used to accurately describe specific job-site conditions that provoke error:

- *Task Demands* – Specific mental, physical, and team requirements to perform an activity that may either exceed the capabilities or challenge the limitations of human nature of the individual assigned to the task; for example, excessive workload, hurrying, concurrent actions, unclear roles and responsibilities, or vague standards.
- *Individual Capabilities* – Unique mental, physical, and emotional abilities of a particular person that fail to match the demands of the specific task; for example, unfamiliarity with the task, unsafe attitudes, level of education, lack of knowledge, unpracticed skills, personality, inexperience, health and fitness, poor communication practices, or low self-esteem.
- *Work Environment* – General influences of the workplace, organizational, and cultural conditions that affect individual behavior; for example, distractions, awkward equipment layout, complex tagout procedures, at-risk norms and values, work group attitudes toward various hazards, or work control processes.

Attachment 3 – Anatomy of an Event Model

- *Human Nature* – Generic traits, dispositions, and limitations of being human that may incline individuals to err under unfavorable conditions; for example, habit, short-term memory, fatigue, stress, complacency, or mental shortcuts.
- *Flawed Defenses* – Defects that under the right circumstances may inhibit the ability of measures to protect plant equipment or people against hazards or fail to prevent the occurrence of active errors.

Defenses or barriers fulfill various functions:

- Create awareness and understanding of the risks and hazards.
- Detect and warn about the presence of off-normal conditions or imminent dangers.
- Protect people, equipment, the environment and the project from injury, damage, and undesired consequences.
- Recover from off-normal conditions and restore the facility, equipment or the organization to a safe state.
- Contain the accidental release of harmful energy or substances.
- Enable the potential victims to escape out-of-control hazards.

When an event occurs, either there is a flaw with existing defenses or appropriate defenses are not in place.

Defense-in-depth is achieved by systematically and redundantly applying multiple barriers to prevent undesired outcomes. A caution is in order since redundant defenses can add complexity to a task. Performance may be more difficult because failed or flawed defenses become harder to see. This is one reason latent weaknesses persist. Therefore, defense-in-depth can be a two-edged sword: added safety margin with added complexity.

Attachment 3 – Anatomy of an Event Model

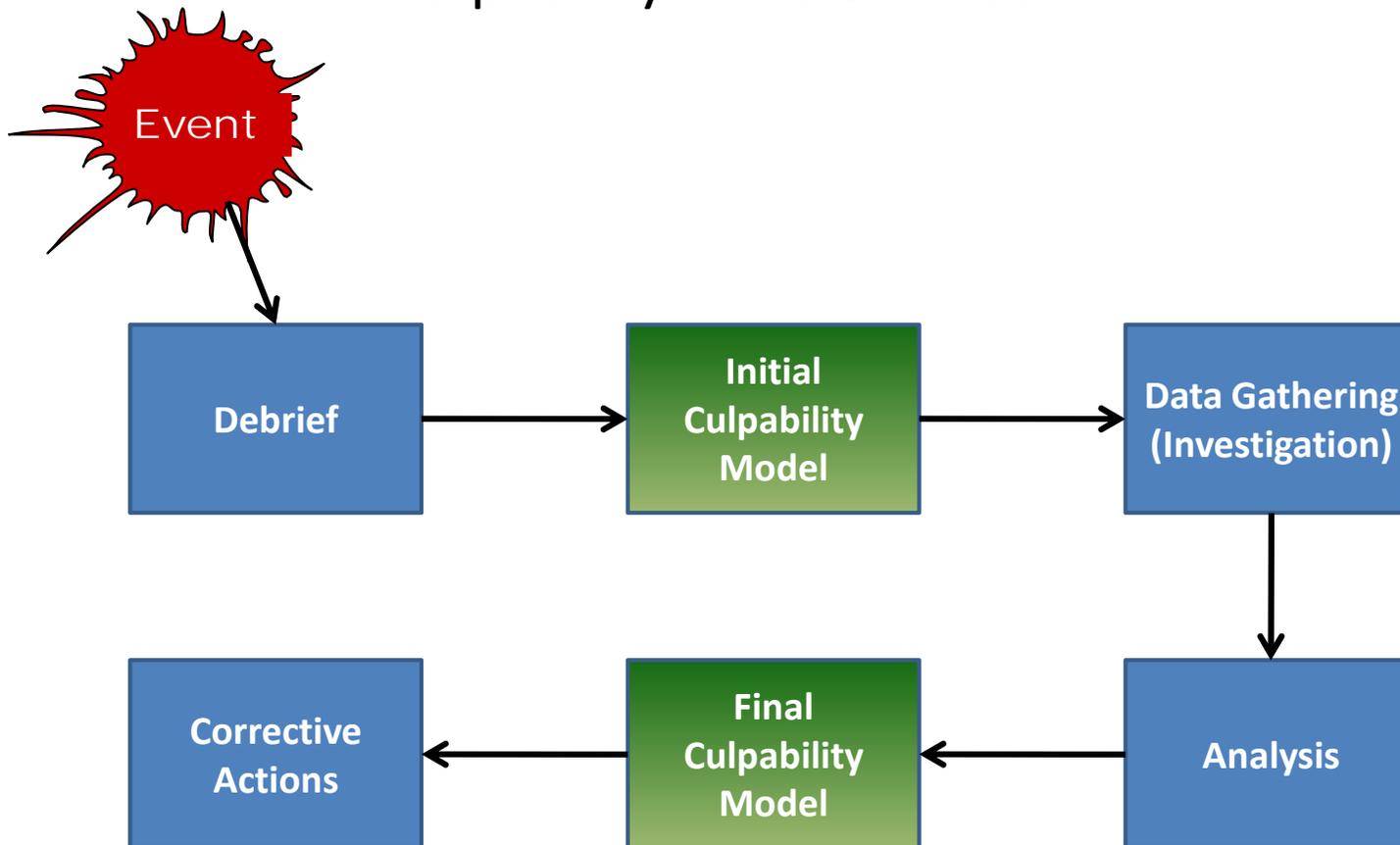
Latent Organizational Conditions (Weaknesses) – situations resulting from management control processes (for example, strategy, policies, work control, training, and resource allocation) or values (shared beliefs, attitudes, norms, and assumptions) creating workplace conditions that can provoke error (precursors) and degrade the integrity of defenses (flawed defenses). Given that the root causes of most plant events originate at the organizational level, processes and values are the avenues that offer the greatest leverage for improvement in human performance. And, since these latent organizational conditions exist before an event occurs, they are manageable such that when weaknesses are proactively identified, they can be corrected before an event occurs. The decisions and activities of the station's managers and supervisors determine what is done, how well it is done, and when it is done, either contributing to the health of the organization or further weakening its resistance to error and events. Therefore, managers and supervisors should perform their duties with the same respect for error-prone work environments as workers, who are expected to maintain a healthy wariness on the job. Understanding the major role organization plays in the performance of a facility, a second strategic thrust to preventing events should be the identification and elimination of latent organizational conditions destructive to the safety, quality, and productivity of the organization.

A popular misconception persists throughout most industries that people must possess a lack of proper motivation when they err or act carelessly or without clear judgment. However, events occur more often due to error-prone tasks and error-prone work environments than from error-prone individuals. Error-prone tasks and work environments are typically created by latent organizational conditions; latent in the sense that such situations are hidden to causal inspection. Such deficiencies or weaknesses occupy areas of organization such as the following examples (no significance denoted by the order):

- Training Programs
- Work Management
- Self Assessment Program
- Corrective Action Program
- Procedure Development Processes
- Managerial and Supervisory Styles
- Maintenance Programs
- Goals and Business Plans
- Priorities
- Planning and Scheduling
- Design and Modification Processes
- Lockout/Tagout Instructions

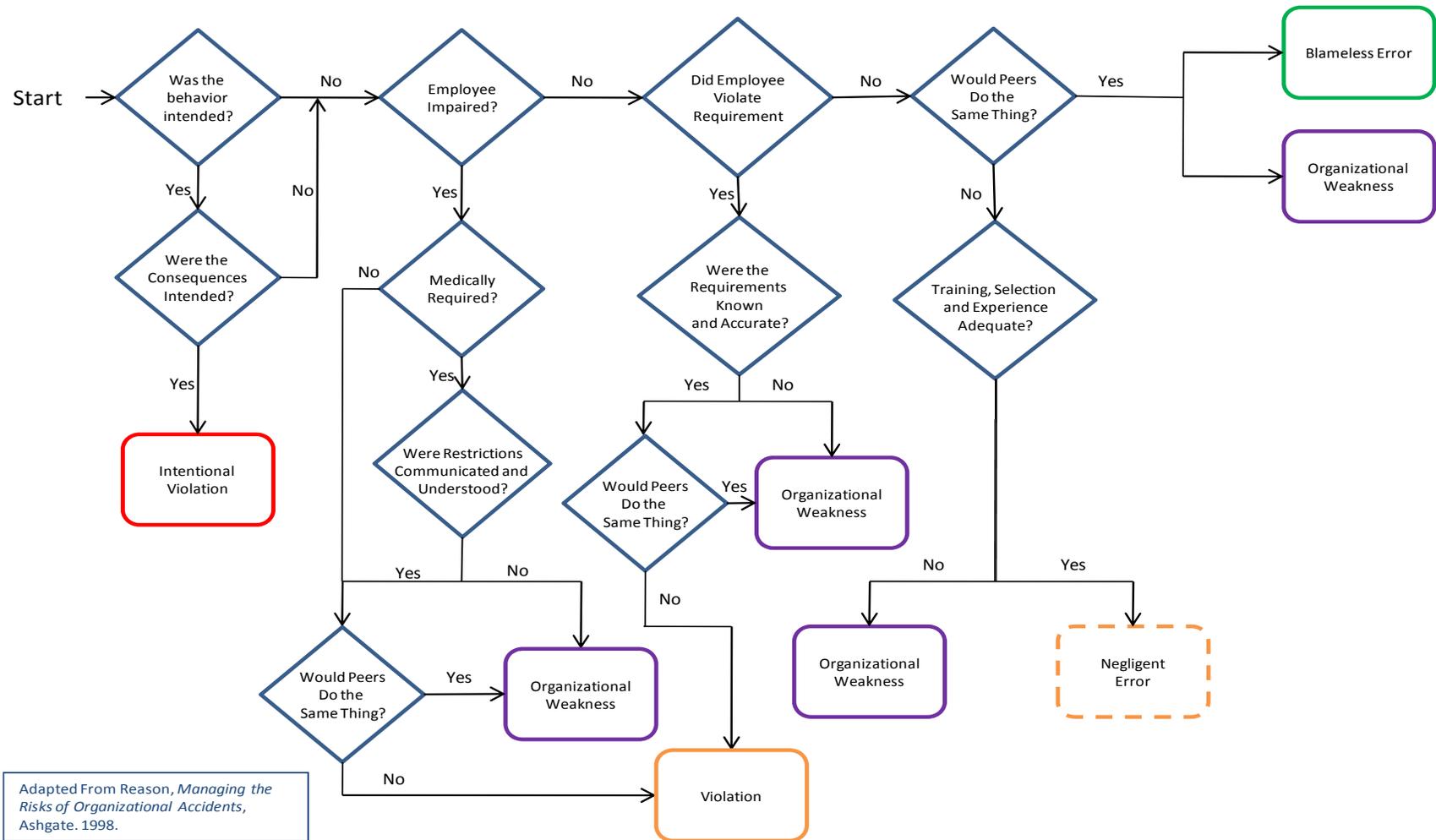
Attachment 4 – Culpability Decision Model

Event Analysis with Culpability Decision Model



Attachment 4 – Culpability Decision Model

WIPP CULPABILITY DECISION MODEL



Attachment 5 – Error Precursors and Definitions

P1-Task Demands	Description
Time pressure (in a hurry)	Urgency or excessive pace necessary to perform action or task manifested by shortcuts, being in a hurry, and an unwillingness to accept additional work or to help others. No spare time.
High workload (high memory requirements)	Mental demands on individual to maintain high levels of concentration; for example, scanning, interpreting, deciding, while requiring recall of excessive amounts of information (either from training or earlier in the task).
Simultaneous, multiple tasks	Performance of two or more activities, either mentally or physically, that may result in divided attention, mental overload, or reduced vigilance on one or the other task.
Repetitive actions/monotony	Inadequate level of mental activity resulting from performance of repeated actions; boring. Insufficient information exchange at the job site to help the individual reach and maintain an acceptable level of alertness.
Irreversible acts	Action that cannot be undone. No obvious means of reversing an action.
Interpretation requirements	Situations that require "in-field" diagnosis, potentially leading to misunderstanding or application of wrong rule or procedure.
Unclear goals, roles, or responsibilities	Unclear work objectives or expectations; Uncertainty about the duties an individual is responsible for in a task in which other individuals are involved; Duties that are incompatible with duties of others.
Lack of or unclear standards	Ambiguity or misunderstanding about acceptable behaviors or results; if unspecified, standards default to those of the front-line worker (good or bad).
Confusing procedure/vague guidance	Direction is imprecise, difficult to follow, or contradictory; Instruction is nebulous, lacks sufficient detail, is disconnected or does not flow as expected.
Excessive communication requirements	The need to inform others of task progress or status overshadows accomplishment of the task and can become distracting.

Attachment 5 – Error Precursors and Definitions

P1-Task Demands	Description
Delays; idle time	Leads individuals to lose focus on the activity, to relax their vigilance and weaken their situational awareness.
Complexity/High Information flow	Task difficulty may exceed the individual's capability and lead to poor problem solving and decision making. Too much information can cause forgetfulness and lead to errors of omission.
Excessive time on task	Can lead to fatigue, boredom, anxiety, and the urge to hurry to be done.
Long-term monitoring (vigilance decrement)	Monitoring tasks in which 'hits' are relatively few and far between can lead to missing obvious problems as an individual's vigilance degrades. This condition is prevalent when the variety of the work is unchanged and/or there is little opportunity for rest breaks.

P2-Work Environment	Description
Distractions/ interruptions	Conditions of either the task or work environment that require the individual to stop and restart a task sequence, diverting attention to and from the task at hand.
Changes/departure from routine	Departure from a well-established routine; Unfamiliar or unforeseen task or job-site conditions that potentially disturb an individual's understanding of a task or equipment status.
Confusing displays/controls	<p>Characteristics of installed displays and controls that could confuse or exceed the working memory capability of an individual.</p> <p>Examples:</p> <ul style="list-style-type: none"> • Missing or vague content (insufficient or irrelevant). • Lack of indication of specific process parameter. • Illogical organization and/or layout. • Insufficient identification of displayed process information. • Controls placed close together without obvious ways to discriminate conflicts between indications.

Attachment 5 – Error Precursors and Definitions

P2-Work Environment	Description
Workarounds/out-of-service instrumentation	Uncorrected equipment deficiency or programmatic defect that necessitates compensatory or nonstandard action to comply with a requirement; long-term materiel condition problems that place a burden on the individual.
Hidden system response	System response invisible to individual after manipulation; Lack of information conveyed to individual that previous action had any influence on the equipment or system.
Unexpected equipment condition	System or equipment status not normally encountered, creating an unfamiliar situation for the individual.
Lack of alternative indication	Inability to compare or confirm information about system or equipment state because of the absence of instrumentation.
Personality conflict	Incompatibility between two or more individuals working together on a task, causing a distraction from the task because of preoccupation with personal differences.
Back shift or recent shift change	People in these circumstances are subject to fatigue associated with the circadian ('around a day') rhythms of the body. Fatigue reaches its peak in the early hours of the morning (about 03.00). If recently changed to day shift from back shift, circadian rhythm may not have returned to normal.
Excessive group cohesiveness/peer pressure	The bond between members of a work group can be so strong that individuals in the group are reluctant to disagree. This can lead to "groupthink", a reluctance to share contradictory information about a problem for the sake of maintaining the harmony of the work group. This condition is detrimental to critical problem solving.
Production overemphasis	Cost and schedule, product volume, customer satisfaction takes precedent over protection (safety). Organizations have a tendency to borrow from safety to satisfy production goals until they undergo a mishap that causes the pendulum to swing back.
Adverse physical climate (habitability)	Work site is too cold or too hot, is poorly lighted, or is too noisy; Work area is cluttered with equipment, machinery, components that make it difficult to accomplish assigned work.

Attachment 5 – Error Precursors and Definitions

P2-Work Environment	Description
No accounting of performance	Supervision is habitually vacant in the work areas. Individual responsibility for accomplishing quality work is ignored. Poor work performance is not corrected and good work performance is not recognized (null consequences).
Poor equipment layout-poor access	Functionally related components are not grouped together. Equipment and components are not clearly and informatively labeled. Ease of maintainability has not been achieved.
Fear of consequences of error	Actual or perceived: naming, blaming and shaming in the organization, formal retribution, memo to file, time off without pay, relieved of responsibilities, fired.
Mistrust among work groups	To regard without confidence, to be wary or doubtful; where mistrust prevails among work groups, confidence in each other's abilities does not exist; this leads to poor coordination and failure to communicate effectively.
Meaningless rules	Rules that restrict or control individual or group activities/behaviors in areas that have no apparent value. They are not related to safety, quality, productivity, or to any other measure of consequence including human resource expectations and the like.
Unavailable parts or tools	The lack of proper parts and tools can lead to improvisation by workers to get the job done; Improvised parts often do not meet standards; Tools fashioned by workers may not be exacting or precise, and result in hazards to workers themselves.
Acceptability of "cook-bookings" practices	"Cook booking" is mindless procedural compliance without self-checking or verifying the correct response to one's actions.
"Rule Book" culture	An environment in which employees are expected to comply with the procedures and work instructions no matter what the circumstances. Suggestions are discouraged.
Equipment sensitivity (inadvertent actions)	The ease with which unintended or incidental actions can alter equipment performance or status. Motors or pumps trip readily with vibrations or increased heat. Fire protection sprinklers set off by a non-fire incident. Radiation detection hand frisker picking up errant radiation counts.

Attachment 5 – Error Precursors and Definitions

P2-Work Environment	Description
Lack of clear strategic vision or goals	In the absence of a clear vision or goals, workgroups will typically set expectations they believe management wants and supports. Worker expectations can run counter to good practice and are often adverse to worker and facility safety.
Identical and adjacent displays/controls	Switches, knobs, buttons, and indicators that look alike and appear in close proximity increase the risk of an operator taking the wrong reading or manipulating the wrong control.
Out-of-service warning systems	Fire alarms, radiation and criticality control alarms, and other warning system devices that do not function correctly can lead to errors due to lack of information.
Nuisance alarms	Minor, unimportant status alarms that require no corrective action; people become desensitized to alarms and start to unconsciously conclude that all alarms are just minor nuisances.
Lack of place-keeping	Place keeping involves physically marking completed steps in a procedure. Effective place keeping prevents omitting or duplicating steps, or performing a series of steps in an incorrect sequence.

P3-Individual Capabilities	Description
Unfamiliarity with task/first time	Unawareness of task expectations or performance standards; first time to perform a task (not performed previously; following a significant procedure change).
Lack of knowledge (faulty mental model)	Unawareness of factual information necessary for successful completion of a task; lack of practical knowledge about the performance of a task.
New technique not used before	Lack of knowledge or skill with a specific work method required to perform a task.
Imprecise communications	Communication habits or means that do not enhance accurate understanding by all members involved in an exchange of information.
Lack of proficiency/inexperience	Degradation of knowledge or skill with a task because of infrequent performance of the activity.

Attachment 5 – Error Precursors and Definitions

P3-Individual Capabilities	Description
Indistinct problem-solving skills	Unsystematic response to unfamiliar situations; inability to develop strategies to resolve problem scenarios without excessive use of trial-and-error or reliance on previously successful solutions; unable to cope with changing plant conditions.
Unsafe attitude for critical tasks	Personal belief in prevailing importance of accomplishing the task (production) without consciously considering associated hazards; perception of invulnerability while performing a particular task; pride; heroic; fatalistic; summit fever; Pollyanna; bald tire.
Illness/fatigue	Degradation of a person's physical or mental abilities caused by a sickness, disease, or debilitating injury; lack of sufficient physical rest to support acceptable mental alertness and function.
Unawareness of critical parameters	Critical parameters define the extreme safe operating boundaries for systems. Allowing a system to operate outside the critical parameter increases the risk of equipment failure and possible injury to workers and harm to the environment.
Inappropriate values	Inappropriate values fly in the face of safety. They include taking undue risks to get the job done; shortcutting the procedure to save time; signing off work as completed that was not completed. Skipping the pre-job briefing to stay on schedule, etc.
Major life event: medical, financial, and emotional	A major event in one's personal life such as the loss of a loved one, a marital separation or a divorce, a major health downturn, loss of a home etc. causes stress, worry, sleeplessness and fatigue – can be a major distracter on the job.
Poor manual dexterity	Lack of skill and ease of performance in the use of the hands can cause difficulties in properly operating controls or using tools effectively.
Low self-esteem; moody	The lack of pride or confidence in ones abilities can negatively affect the individual's performance. People who are moody are irritable, impatient, and worked up. They may be volatile, flighty, unsteady and erratic.
Questionable ethics (bends the rules)	An unprincipled individual lacking integrity and honor is willing to doctor the logbook, fudge on performing rounds, read non-essential materials at the control panel, use the office phone for personal business and cheat on his timecard.

Attachment 5 – Error Precursors and Definitions

P3-Individual Capabilities	Description
Sense of control/learned helplessness	A condition in which the individual believes they are powerless to perform adequately and to achieve a positive outcome. Continued failure to achieve self-imposed goals and routine dependence on others to carry the load leads to lack of self-worth and the inability to improve the condition – helplessness and boredom.
P4-Human Nature	Description
Stress	Mind's response to the perception of a threat to one's health, safety, self-esteem, or livelihood if task is not performed to standard; responses may involve anxiety, reduced attention, reduced working memory, poor decision-making, transition from accurate to fast; degree of stress reaction dependent on individual's experience with task.
Habit patterns	Ingrained or automated pattern of actions attributable to repetitive nature of a well-practiced task; inclination formed for particular train/unit because of similarity to past situations or recent work experience.
Assumptions	Suppositions made without verification of facts, usually based on perception of recent experience; provoked by inaccurate mental model; believed to be fact; stimulated by the inability of the human mind to perceive all facts pertinent to a decision.
Complacency/overconfidence	A "Pollyanna" effect leading to a presumption that all is well in the world and that everything is ordered as expected; self-satisfaction or overconfidence with a situation; unaware of actual hazards or dangers; particularly evident after 7-9 years on the job; underestimating the difficulty or complexity of a task based on past experiences.
Mindset	Tendency to "see" only what the mind is <i>tuned</i> to see (intention); preconceived idea; information that does fit a mind-set may not be noticed and vice versa; may miss information that is not expected or may see something that is not really there; contributes to difficulty in detecting one's own error(s).

Attachment 5 – Error Precursors and Definitions

P4-Human Nature	Description
Inaccurate risk perception	Personal appraisal of hazards and uncertainty based on either incomplete information or assumptions; unrecognized or inaccurate understanding of a potential consequence or danger; degree of risk-taking behavior based on individual's perception of possibility of error and understanding of consequences; more prevalent in males.
Mental shortcuts (biases)	Tendency to look for or see patterns in unfamiliar situations; application of thumb rules or "habits of mind" (heuristics) to explain unfamiliar situations.
Limited short-term memory	Forgetfulness; inability to accurately attend to more than 2 or 3 channels of information (or 5 to 9 bits of data) simultaneously.
Pollyanna effect	Pollyanna is a person regarded as being foolishly or blindly optimistic. People tend to presume that all is normal and perfect in their immediate surroundings. This attitude promotes an inaccurate perception of risk and can lead individuals to ignore unusual situations or hazards, causing them to react either too late or not at all.
Limited perspective	Humans cannot see all there is to see. The inability of the human mind to perceive all facts pertinent to a decision challenges problem solving. This is similar to attempting to see all the objects in a locked room through the door's keyhole. This limitation causes an inaccurate mental picture or model and to underestimate the risk.
Avoidance of mental strain	Thinking is a slow, laborious process that requires considerable effort. Consequently, people tend to look for familiar patterns and apply well-tried solutions from the past to a current problem. They are tempted to settle for satisfactory rather than the best solutions.
First day back from vacation/days off	Concentration on the task and attention to detail are not as crisp following several days being off the job. The mind tends to wander to the adventures, the happenings, and pleasures of the previous days.
Sugar cycle (after a meal)	Eating too much sugar causes excessive blood sugar. When sugar levels in the blood fluctuate following a meal, feelings of fatigue and exhaustion can result. Headaches and mood swings are also apparent when the blood sugar is unstable.

Attachment 5 – Error Precursors and Definitions

P4-Human Nature	Description
Fatigue (sleep deprivation and biorhythms)	Fatigued workers can become more cranky and irritable. They have trouble controlling their attention. Information slips out of short-term memory more easily and memory lapses become more likely. Research shows that moderate sleep deprivation of the kind experienced by shift workers can have consequences that are very similar to those produced by alcohol.
Tunnel vision (lack of big picture)	A constricted visual field in which peripheral perception is eliminated. An extremely narrow point of view; narrow mindedness.
"Something is not right" (gut feeling)	The subconscious level of attention continually receives information from the immediate environment. A "gut feeling" that something is not right is a signal that the subconscious has detected something that is inconsistent with the present situation, goals or intent.
Pattern-matching bias	People tend to avoid mental strain because thinking is hard and requires high levels of attention for extended periods. There is a tendency to find a situation in one's past experience that is similar to a situation being faced today and to match the two situations. This "pattern-matching" gives the individual justification to address the current situation as they did in the past situation.
Social deference (excessive professional courtesy)	People generally have difficulty disagreeing with an individual on their work team who may be highly educated, or a recognized subject matter expert, or on the management chain. This results in a blind (perhaps risky) trust in the competence of specific individuals.
Easily bored	Boredom usually results from too little stimulation, motivation and interest. It is characterized by wandering attention, impaired efficiency, and low levels of arousal. The affected individual feels a pervasive lack of interest in and difficulty concentrating on the current activity.
Close-in-time cause-effect correlation	People tend to assign a cause-effect relationship between two events because they occur almost at the same time.
Difficulty seeing own errors	Individuals are particularly susceptible to omissions, especially when working alone. People who are too close to a task, or are preoccupied with other tasks, may fail to detect abnormalities.

Attachment 5 – Error Precursors and Definitions

P4-Human Nature	Description
Frequency and similarity biases	Frequency bias is a gamble that a frequently used solution will work; giving greater weight to information that occurs more frequently or is more recent. Similarity bias is the tendency to recall solutions from situations that appear similar to those that have proved useful from past experience.
Availability bias	The tendency to settle on solutions or courses of action that readily come to mind and appear satisfactory. More weight is placed on information that is available (even though it could be wrong).
Imprecise physical actions	Timing is too early or too late, duration of the action is too long or too short. One can perform the wrong action on a correct object, or correct action on wrong object. Turning the valve too tight, turning the switch the wrong direction; turning the wrong valve or switch.
Limited attention span	Attention concentration is hard to sustain for more than a moment. Unrelated matters can capture attention (preoccupations or distractions). Humans can only attend to a very small proportion of the available sense data. If attention is strongly drawn to one particular thing, it is necessarily withdrawn from other competing concerns. Thus, attention is a limited commodity.
Spatial disorientation	An individual's perception of direction does not agree with reality in this condition. Spatial disorientation can place a worker in a location in the facility wherein he/she may turn the wrong valve, lock and tag the wrong component, etc.
Physical reflex	The reaction to a loud noise, a bright burst of light, or unusual activity in the area. This reflex becomes a distracter that weakens attention.
Anxiety (involving uncertainty)	Stress is the body's mental and physical response to a perceived threat in the environment. Stress increases as familiarity with a situation decreases. It can result in panic, inhibiting the ability to effectively sense, perceive, recall, think or act. Anxiety and fear usually follow when an individual feels unable to respond successfully. Along with anxiety and fear, memory lapses are among the first symptoms to appear.

Attachment 6 – Defenses/Barriers by Performance Category

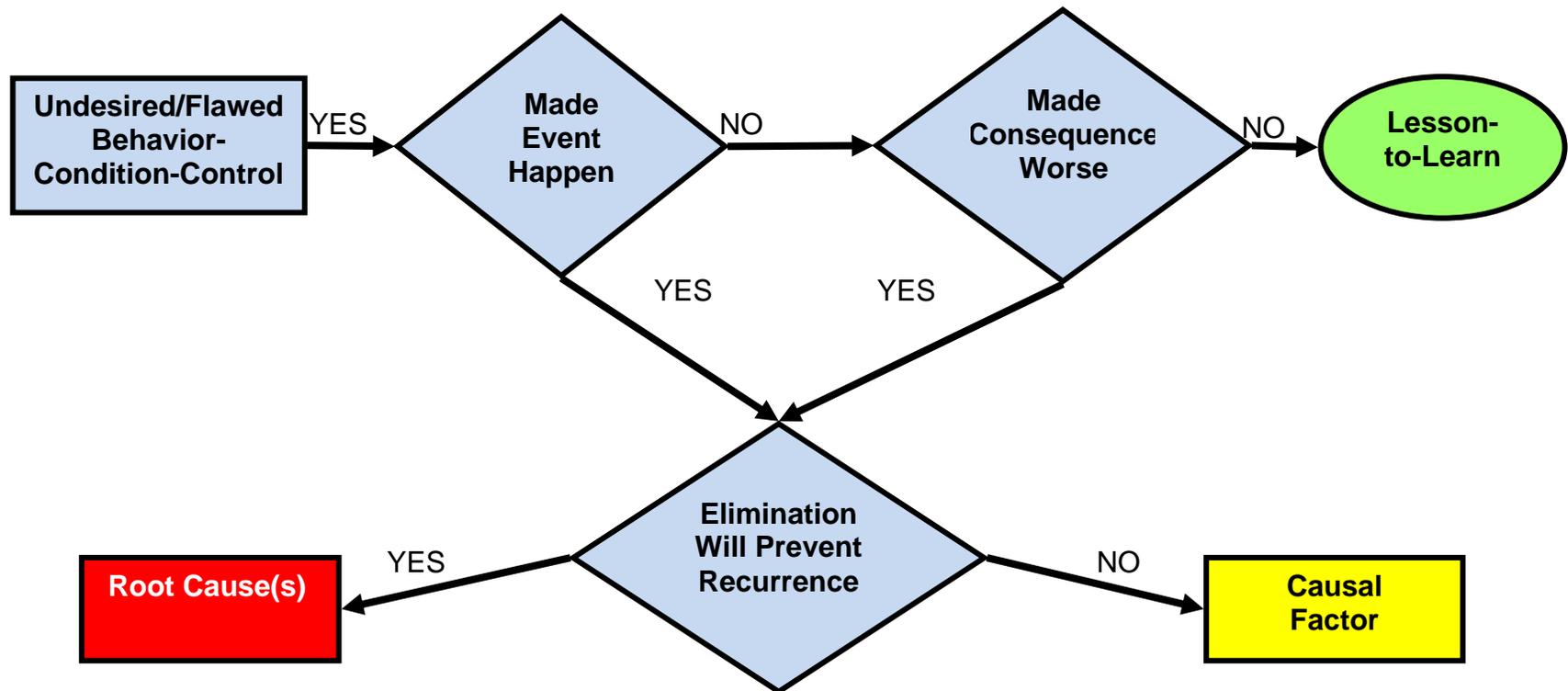
D1-Organizational Factors		D2-Job-Site Conditions	
A	Training	A	Equipment Ergonomics & Human Factors
B	Procedure Revisions	B	Environmental Conditions
C	Meetings	C	Work-arounds & Inconveniences
D	Compatible Goals and Priorities	D	Procedure / Work Package Quality
E	Reviews & Approvals	E	Equipment Labeling & Equipment Condition
F	Role Models	F	Lockout/Tagout
G	Safety Culture	G	Tool Quality & Availability
H	Morale, Values & Beliefs	H	Intolerance for Error Traps
I	Roles & Responsibilities	I	Foreign Materials Exclusion
J	Staffing	J	Radiation Work Permits
K	Operating Experience	K	Turnover
L	Work Management	L	Clearance Walkdown
M	Scheduling and Sequencing	M	Task Preview, Pre-job Briefing
N	Simple/Effective Processes	N	Just-in-Time Operating Experience
O	Design & Configuration Controls	O	Flagging
P	Problem Solving	P	Housekeeping
Q	Task Allocations	Q	Effective Communication
R	Self Assessment/ Corrective Action Program	R	Concurrent Verification
S	Trend Analysis	S	Supervision
T	Change Management	T	Peer-Checking
U	Benchmarking	U	Job-site Review
V	Communication Practices & Plan	V	QC Hold Points
W	Labor Relations	W	Independent Verification
X	Management & Independent Oversight	X	Interlocks
		Y	Alarms

Attachment 6 – Defenses/Barriers by Performance Category

D3-Individual		D4-Leadership	
A	Worker Knowledge, Skill & Proficiency	A	Clear Expectations
B	Questioning Attitude/Stop When Unsure	B	Coaching
C	Procedure Use and & Adherence	C	Accountability
D	Conservative Decision-Making	D	Respect for Others
E	Self-Checking	E	High Standards
F	Place-Keeping	F	Reinforcement
G	Problem-solving Methodology	G	Motivation
H	Recognizing Error Traps	H	Courage & Integrity
I	Team Skills	I	Healthy Relationships
J	Situation Awareness	J	Proper Reactions
K	Personal Protective Equipment	K	Compelling Vision
L	Fitness-for-Duty	L	Sets Example
M	Personal Motives	M	Open & Honest Communication

D5-Plant Results	
A	Equipment Reliability
B	Containment
C	Safeguards Equipment
D	Reactor Protection Systems
E	Post-job Review
F	Problem Reporting
G	Feedback, Rewards & Reinforcement

Attachment 7 – Test for Significance of Causal Factors



Modified from W Corcoran & R Hartley

Attachment 8 – Latent Organizational Weaknesses

O-1 Culture	
A	Lack of clear strategic vision or goals
B	Misaligned values and beliefs
C	Flawed risk management
D	Meaningless rules
E	Unjust Climate - Punishment vs. Accountability
F	Lack of accountability
G	Unclear roles and responsibilities
H	Lack or unclear lines of communications
I	Too high priority placed on schedules
J	High operating tempo (workload, time pressure, stress)
K	Insufficient funding; excessive cost/staff cuts
L	Inadequate quantity or quality of facility resources, tools, parts, procedures, support
M	Willingness to accept degraded conditions or performance
N	Biased hiring, firing, and promotion practices
O	Inadequate use of performance monitoring
P	Lack of Self-Assessment; Internal/External Oversight
Q	Failure to perform management observations and coaching
R	Management policies discourage worker input
O-2 Programs	
A	Conflicting goals or requirements between programs
B	Less than adequate (LTA) Training Program: Training is not consistent with the equipment, procedures or process Focus on lower level of cognitive knowledge No task qualification requirement when the task is skill-based Management not involved in training
C	LTA Procedures Program: Omission of necessary functions in procedures Assumptions made in lieu of procedure guidance Critical steps not considered Inadequate application of hazard controls Failure to consider human error Failure to perform procedure verification or validation

Attachment 8 – Latent Organizational Weaknesses

O-2 Programs	
D	LTA Oversight Program: Inadequate program oversight
E	LTA Work Control Program: Lack of standardized procedures Craft, safety professionals, engineers involved throughout Ineffective scheduling with respect to other activities and resource availability
F	LTA Lessons Learned/Corrective Action Program: Ineffective use of operating experience Ineffective critique/investigation process Weak corrective action No effectiveness reviews
G	LTA Safety Program: Process/Job Hazard Analysis Hazard Controls - Nuclear Safety
H	LTA Engineering Program: Poor relationship with operations and maintenance Poor design Inadequate involvement of users in design changes